

What are the valid names
for the two genetically different taxa currently included
within *Pontia daplidice* (Linnaeus, 1758) ?
(Lepidoptera : Pieridae)

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Summary

Electrophoretic studies have revealed two genetically different, parapatric taxa included within *Pontia daplidice* (LINNAEUS, 1758), the European "Bath White" butterfly. No morphological character has yet been found by which the two taxa can be distinguished reliably. Here it is proposed to use the name *daplidice* LINNAEUS, 1758, for the western butterfly (taxon 1 of GEIGER & SCHOLL, 1982), and the name *edusa* FABRICIUS, 1777, for the eastern butterfly (taxon 2 of GEIGER & SCHOLL, 1982).

Zusammenfassung

Elektrophoretische Studien haben ergeben, daß sich unter *Pontia daplidice* LINNAEUS, 1758, zwei genetisch verschiedene, parapatrische Taxa verbergen. Der Vergleich der männlichen Kopulationsorgane und der Zeichnungen der Falter erbrachte bisher kein Merkmal, durch das beide Taxa eindeutig unterschieden werden können. Es wird vorgeschlagen, den Namen *daplidice* LINNAEUS, 1758 für die westliche Form (taxon 1 bei GEIGER & SCHOLL, 1982), und den Namen *edusa* FABRICIUS, 1777, für die östliche Form (taxon 2 bei GEIGER & SCHOLL, 1982) zu verwenden.

Résumé

Des recherches électrophorétiques ont révélé que sous *Pontia daplidice* LINNAEUS, 1758 se cachait deux taxa génétiquement différents, parapatriques. La comparaison des organes génitaux mâles et du dessin des ailes n'a jusqu'à présent pas permis de trouver de caractères suffisants pour distinguer nettement les deux taxa. L'auteur propose le nom de *daplidice* LINNAEUS, 1758 pour la forme occidentale (taxon 1 dans GEIGER & SCHOLL, 1982), et celui d'*edusa* FABRICIUS, 1777, pour la forme orientale (taxon 2 chez GEIGER & SCHOLL, 1982).

Introduction

GEIGER & SCHOLL (in the preceding article) showed that two genetically distinct parapatric taxa have been included within *Pontia daplidice* (LINNAEUS, 1758). DESCIMON (also in the preceding article) demonstrated, through hybridization experiments, that pairings between the two taxa are easily obtained, but are largely infertile.

The taxonomic and nomenclatural problems posed by these discoveries are discussed here with special reference to current work on the butterflies of Turkey (HESSELBARTH, VAN OORSCHOT & WAGENER, in prep.). In particular, the following questions are raised : to which of the two genetically different taxa do the Turkish populations belong ? ; are there any morphological characters which can be used to identify individual specimens with confidence ? ; and what are the valid names for the two taxa ?

The first two questions have been addressed in the preceding article by GEIGER, DESCIMON & SCHOLL. Here I add additional data and observations from my own morphological work, before considering the nomenclatural problems.

Additional data on the differentiation of the two taxa and their distribution

1. MATERIALS AND METHODS

1.1. In 1985 the author collected live material in different provinces of Turkey and sent it to Bern for electrophoresis. Of 9 specimens, 8 belonged to the eastern form, 1 to the western. The western example, a female, came from the Great Zab Valley, at 1000 m, about 25 km NNW of Çukurca, in Hakkari Province, near the Iraqi frontier. A female of the eastern form was found only about 15 km away, at about 1300 m high in the valley of a tributary of the Great Zab, on the eastern side of the Suvarihalil Pass. Subsequent electrophoretic studies by GEIGER revealed two further specimens, both males, belonging to the eastern form. The results of dissection of these two males are discussed below (2.3).

1.2. Previous studies (see GEIGER, DESCIMON & SCHOLL, 1988) revealed an apparent difference in male genital valve outline between the eastern and western taxa. I examined the genitalia of 65 males from within the accepted range of nominal *Pontia daplidice* and, by making outline drawings of the valves to the same magnification on transparent paper, I matched their outlines, paying particular attention to the distal margins. The results were scored as 6 different types (Fig. 1 and Table 1), with types 1 and 6

locality	♂-♀	slide	valve type	electrophoresis
Finland, Tytärsaari	♂	AC 1492	3 ed	-
Sweden, Gotland	♂	AC 1493	2 ed	-
Great Britain, Dover	♂	AC 1474	2 ed	-
Great Britain, Falmouth	♂	AC 1477	3 ed	-
Great Britain, Isle of Thanet	♂	AC 1475	3 ed	-
Great Britain, North Cornwall	♂	AC 1476	3 ed	-
France, Ile-et-Villaine	♂	AC 1497	3 ed	-
France, Ile-et-Villaine	♂	AC 1504	3 ed	-
France, Finisterre	♂	AC 1500	2 ed	-
France, Digne	♂	AC 1464	3 ed	-
Portugal, Faro	♂	AC 1502	3 ed	-
Mallorca, Palma	♂	WA 2042	1 ed	-
Italia, Isola d'Elba	♂	WA 2031	3 ed	-
Italia, Isola d'Elba	♂	WA 2027	2 ed	-
Switzerland, Valais, Martigny	♂	AC 1468	3 ed	-
Germany, BRD, Bensheim a.d.Bergstr.	♂	WA 2030	2 ed	-
Germany, DDR, Leipzig	♂	AC 1465	3 ed	-
Germany, DDR, Meißen	♂	AC 1466	3 ed	-
Austria, Vienna	♂	AC 1467	3 ed	-
Hungary, TREITSCHKE coll.	♂	AC 1488	3 ed	-
Hungary, TREITSCHKE coll.	♂	AC 1489	2 ed	-
LINNEAN coll.	♂	AC -	3 ed	-
Yugoslavia, Dalmatia, Orebic	♂	WA 2043	3 ed	-
Yugoslavia, Macedonia	♂	AC 1469	2 ed	-
Greece, 35 miles N Saloniki	♂	AC 1470	2 ed	-
Greece, Phthiotidos, 20 km S Lamia	♂	WA 2039	3 ed	-
Greece, Makedonia, Falakron Oros	♂	WA 2032	3 ed	-
Bulgaria, Ograzden Planina	♂	WA 2038	1 ed	-
Turkey, Çanakkale, Gallipoli	♂	WA 2026	2 ed	-
Turkey, Çanakkale, NE Eceabat	♀	-	-	ed
Turkey, Denizli, Pamukkale	♂	WA 2029	3 ed	♂, 2♀ ed
Turkey, Hatay, Akbes	♂	AC 1501	3 ed	-
Syria, Halep	♂	AC 1503	3 ed	-
Turkey, Urfa, 9 km E Birecik	♀	-	-	ed
Turkey, Urfa, 6 km SW Siverek	♀	-	-	ed
Turkey, Malatya, Tecde	♂	WA 2051	3 ed	-
Turkey, Elazığ, Hazar Gölü	♀	-	-	ed
Turkey, 50 km NW Mardin	♂	WA 2023	3 ed	-
Turkey, Bitlis, 27 km E Tatvan	♂	WA 2028	6 da	ed
Turkey, Bitlis, 27 km E Tatvan	♀	-	-	ed
Turkey, Hakkari, Suvarıhalıl geçidi	♀	-	-	ed
Turkey, Hakkari, Zab Valley, 1300 m	♂	WA 2036	2 ed	ed
Turkey, Hakkari, 16 km NE Hakkari	♂	WA 2040	2 ed	-
Turkey, Hakkari, 22 km WNW Yüksekova	♂	WA 2033	3 ed	-
Iran, Derbend, 25 km N Tehran	♂	WA 2048	2 ed	-
"Perse" ESCALERA	♂	WA 2050	3 ed	-
France, Rennes	♂	AC 1498	4 da	-
France, Rennes	♂	AC 1499	5 da	-
France, Ile-et-Vilaine	♂	AC 1496	6 da	-
France, St.-Germain	♂	AC 1505	6 da	-
France, Basses-Alpes, Annot	♂	AC 1463	5 da	-
France, Pyrénées-orientales, Banyuls-sur-Mer	♂	WA 2021	5 da	-
Sardinia, Villasimius	♂	WA 2055	6 da	-

locality	♂-♀	slide	valve type	electrophoresis
Portugal, Ponsada	♂	AC 1461	5 da	-
Portugal, Gonveia	♂	AC 1462	5 da	-
Morocco, Middle Atlas	♂	AC 1494	5 da	-
Morocco, High Atlas	♂	WA 2022	4 da	-
Algeria, Syntype of <i>albidice</i> OBTHR.	♂	WA 2035	4 da	-
Algeria, région de Géryville	♂	AC 1495	4 da	-
Lebanon, Dj. Sannine	♂	WA 2045	5 da	-
Lebanon, Dj. Barouk	♂	WA 2046	4 da	-
Jordan, Amman	♂	WA 2047	4 da	-
Turkey, Urfa, 26 km SW Siverek	♂	WA 2041	6 da	-
Turkey, Urfa, 8 km W Siverek	♂	WA 2052	4 da	-
Turkey, Hakkari, 25 km NNW Çukurca	♂	-	-	da
Turkey, Hakkari, Zab Valley, Üzümcü, 1200 m	♂	WA 2034	4 da	-
Turkey, Hakkari, Cilo Dağı	♂	WA 2053	4 da	-
Greece, Samos	♂	WA 2054	4 da	-
Hungary, TREITSCHKE coll.	♂	AC 1490	4 da	-
Finland, Helsinki	♂	AC 1491	6 da	-
Afghanistan, Badakshan	♂	WA 2049	4 da	-
USSR, Kasachstan	♂	WA 2044	5 da	-

Table 1. Results of electrophoretic analysis and of examination of the male genitalia. AC = dissected by ACKERY, WA = dissected by WAGENER; da = *Pontia (daplidice) daplidice* LINNAEUS, ed = *Pontia (daplidice) edusa* FABRICIUS.

representing the extremes (previously regarded as characteristic), with 2-5 judged to be transitional.

1.3. A black submarginal spot on the underside of the forewings between veins 3 and 4 (m_3 and cu_1) can be graded, according to GEIGER & SCHOLL, into "clearly visible", "intermediate" and "not visible", and offers another potential character. I examined a combined total of 206 specimens belonging to the two taxa, and segregated them according to sex and generation. The results are presented in Table 2.

2. DISCUSSION

2.1. Electrophoresis revealed both taxa in Turkey, the eastern *and* the western form. The eastern form has the widest distribution, from Çanakkale Province in the north-west, to Hakkari Province in the extreme south-east. The western form occurs in Hakkari, very close to the eastern form.

2.2. Comparison of the valves demonstrated a wide range of variation between the extremes: sharply angled or evenly rounded distal margins (Fig. 1). Most valves correspond to type 3 or 4, whilst types 1 and 6 are represented by the least number of specimens. Following GEIGER & SCHOLL one could perhaps assign types 1-3 (angled) to the eastern form, and types 4-6 (rounded) to the western form.

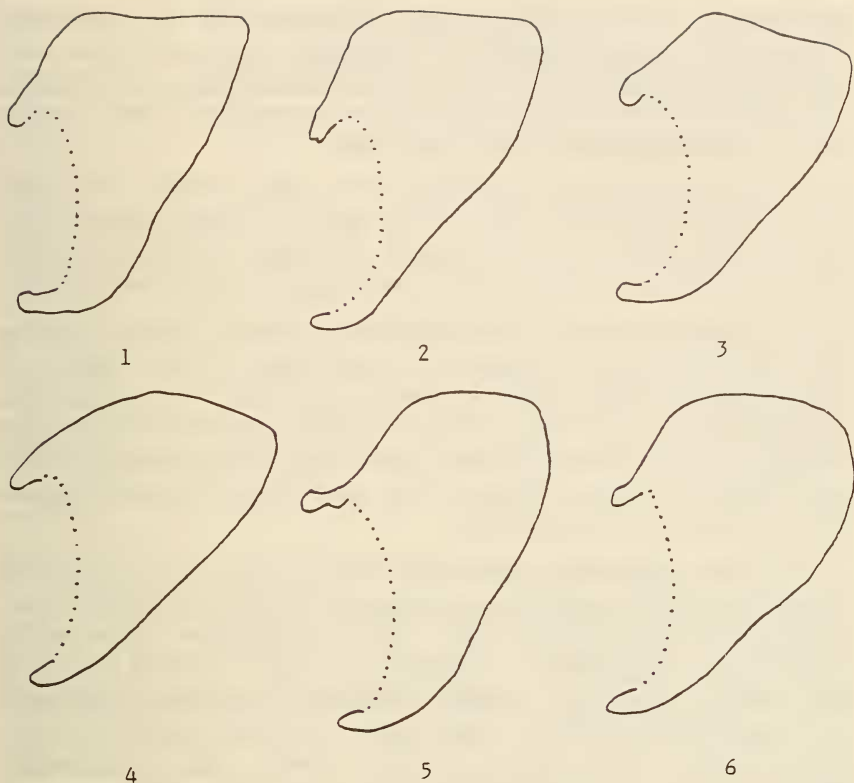


Figure 1. Types of valves in *Pontia* (superspecies) *daplidice*. 1-3 in *Pontia* (*daplidice*) *edusa* FABRICIUS, 4-6 in *Pontia* (*daplidice*) *daplidice* LINNAEUS.

2.3. Two males collected in Turkey in 1985 by the author could not be frozen immediately for electrophoretic analysis. One male, from the southern shore of Lake Van, Bitlis Province, 27 km E of Tatvan, had been dead for five weeks and was totally dry. The other, from Pamukkale, Denizli Province, had been dead for two weeks before it was frozen. The genitalia of both had been separated previously by the author for dissection. According to the allozymes *and* the valves, the Pamukkale male belongs to the eastern form. Electrophoretically, the Lake Van male is also eastern, but its valves proved to be of the most extreme western type (type 6). Thus, assuming that the poor preservation of the Lake Van male did not affect the electrophoretic result, it seems possible that the valve character, even in its most extreme form, is not always a reliable indicator. As a result, even though the general (statistical) relationship may hold, it must be accepted that critical identification of individuals based solely on the male genitalia is not possible ; only

electrophoresis can be considered reliable. Thus specimens with valve types 1-3 have only *a greater probability* of belonging to the eastern form, and individuals exhibiting types 4-6 only more probably belong to the western form. Any statements following based only on examination of male genitalia should be considered in the light of this result.

2.4. The western form has been found at two other localities within the Great Zab Valley (slides WA 2034, 2053), and also at two localities in Urfa Province (WA 2041, 2052). This raises the distinct possibility that the eastern and western forms may be narrowly sympatric in southern Turkey.

2.5. The distributional area of the western form (see fig. 2 in the preceding article) could be enlarged, based on the examination of male genitalia, to include Algeria, Portugal, Sardinia, Lebanon and Jordan. A type 6 male from Finland (thought to be purely "eastern") probably represents a case similar to that of the Lake Van male discussed above, whereas the occurrence of both type 1 and type 6 males on Mallorca (and also in parts of France) suggests that both taxa occur in these areas.

2.6. The black submarginal spot between veins 3 and 4 on the forewing underside is part of the general black wing pattern which, to a variable extent, is overlaid by greenish-yellow scales. Thus the black spot may either be "clearly visible", "not visible" or "intermediate". Table 2 indicates that, in the eastern form, the black spot is usually "not visible" in generatio vernalis, and almost equally "not visible" or "intermediate" in generatio aestivalis. In the western form the black spot is primarily "clearly visible" in generatio aestivalis but, due to lack of material, nothing can be said about the generatio vernalis and autumnalis. No difference is apparent in the samples between males and females. A less detailed examination showed the following percentages :

	"clearly visible"	"intermediate"	"not visible"
eastern form : ♂♂, n = 110	11%	39%	50%
♀♀, n = 68	6%	47%	47%
western form : ♂♂, n = 28	54%	28%	18%
♀♀, n = 5	100%		

GEIGER & SCHOLL (preceding article, fig. 5) obtained similar results from material verified by electrophoretic analysis. But the inconsistency of this character, shifting from "not visible" to "intermediate" and "clearly visible" in subsequent generations, is more suggestive of ecologically induced polyphenic variation rather than any genetic trait. I conclude that, for routine or critical identification of individuals, the black spot character is useless.

locality	vernalis						aestivalis						autumnalis					
	-		#		+		-		#		+		-		#		+	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Finland	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-
Gotland	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Great Britain	-	-	-	1	-	-	2	-	-	-	-	1	-	-	-	-	-	-
France	-	-	-	1	-	-	1	1	1	-	-	-	-	-	-	-	-	-
Aosta Valley, Lake Garda	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-
Lazio: Frosinone, Latina	-	-	-	-	-	1	-	5	-	-	-	-	-	-	-	-	-	-
Calabria: Cosenza	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-
Sicilia: Palermo	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Isola d'Elba	-	-	-	-	-	2	1	2	-	-	-	-	-	-	-	-	-	-
Switzerland: Valais	-	-	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-
Rhine/Main/Neckar-region	-	-	-	-	-	3	1	1	-	-	1	1	-	-	-	-	-	-
Germany: DDR	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Basin of Vienna	7	-	-	-	-	3	1	1	1	1	1	1	1	1	1	-	-	-
Hungary: Nagy-Dorog	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-
LINNEAN Collection	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-
Dalmatia: Orebic	-	-	-	-	-	-	-	-	-	1	1	4	2	2	-	-	-	-
Romania: Transilvania	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
SW-Bulgaria	-	-	-	-	-	2	1	-	-	-	-	1	-	-	-	-	-	-
YU-Macedonia, Greece	1	2	-	-	-	-	4	1	-	-	-	-	-	-	-	-	-	-
Greece: Samos	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Turkey: Istanbul, Bursa	2	1	1	1	-	-	-	-	-	2	1	-	-	-	-	-	-	-
Turkey: Çanakkale, Balıkesir	1	-	-	-	-	1	1	3	-	-	-	-	-	-	-	-	-	-
Turkey: Aydın, Antalya, İçel	-	-	-	-	-	1	1	3	5	1	-	-	-	-	-	-	-	-
Turkey: Afyon, Konya, Tokat	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-
Turkey: Ağrı, Kars, Rize	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-
Turkey: Kayseri, Malatya	-	-	-	-	-	1	3	-	1	-	-	-	-	-	-	-	-	-
Turkey: Adana, Maraş, Hatay	-	-	-	-	-	1	1	2	1	-	-	-	-	-	-	-	-	-
Turkey: Gaziantep, Urfa	-	-	-	-	-	1	2	1	1	2	1	-	-	-	-	-	-	-
Turkey: Elazığ, Diyarbakır	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-
Turkey: Siirt, Van, Hakkari	1	-	-	-	-	2	4	3	1	-	-	-	-	-	-	-	-	-
Turkey: Gümüşhane, Erzurum	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	1	-
Syria: Halep	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Iran: East-Azerbaijan	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Iran: Guilan	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Iran: Elburs Mountains	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-
South-Russia	2	-	-	-	-	1	4	1	-	1	-	-	-	-	-	-	-	-
Alma Ata, Novosibirsk	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Transcaspia: Kavakala	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
France	-	2	1	-	-	2	-	3	2	-	-	-	-	-	-	-	-	-
Sardinia: Villasimius	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mallorca: Palma	-	-	-	-	-	1	-	1	2	-	-	-	-	-	-	-	-	-
Portugal	-	1	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Morocco: Atlas Mountains	1	-	1	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-
Algeria	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Jordan: Amman	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Lebanon Mountains	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Afghanistan: Badakshan	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Kasachstan	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-

Table 2. Appearance of a black spot on forewing underside between vein 3 and 4 in the generations vernalis, aestivalis and autumnalis. - = not visible, # = intermediate, + = clearly visible. Upper part of the table: *Pontia (daplidice) edusa* FABRICIUS, lower part: *Pontia (daplidice) daplidice* LINNAEUS.

2.7. The same conclusion applies to another wing coloration character. Butterflies which have developed in hot and dry conditions tend to show a strong reduction of the black and greenish-yellow markings of the underside. OBERTHÜR (1881) named such individuals from Algeria "var. *albidice*". Similar specimens have mainly been found in the summer generations of North Africa, Spain, Portugal, southern France, the Near East and southern Turkey. Such specimens are believed to belong to the western form but, judging by the valves, some would be assignable to the eastern form. From all of this it can be concluded that we have yet to discover any adult morphological character which would permit reliable identification of individual specimens.

2.8. There are no known differences in the morphology of the preimaginal stages, in behaviour or in ecology. Both taxa are strongly migratory. North of the Alps permanent populations exist only in climatically favoured regions having dry summers (Upper-Rhine-Plain, Thuringia). All other occurrences north of the Alps are migratory in origin. In favourable conditions some of these will give rise to temporary colonies capable of surviving for a few years.

In Central Europe the number of observations decreases from south-east to north-west (Fig. 2). Thus it would appear that migration is initiated in the south-east. In Turkey the eastern form is one of the most common butterflies. At the north-western extreme, temporary colonies have existed from time to time in England, as they did in maritime dune systems in the Netherlands up to 1970. OBERTHÜR (1909 : 121) reported several occurrences in Brittany, but today it seems that the only permanent populations in France all occur south of the Loire (WEIDEMANN, 1986). These western European colonies apparently represent immigrations from southern France and the Iberian Peninsula, and may comprise either or even both forms.

The migratory behaviour, temporary nature of the colonies, and low fertility of the hybrids together suggest that the marginal distribution range of the two taxa may change dramatically through time, and that the establishment of overlap zones (regions of sympatry) is likely to be ephemeral. If so, it would be inappropriate to give the two taxa the status of full species, and preferable instead to regard them as semispecies. Their largely allopatric (parapatric) distribution is paralleled by other semispecific pairs amongst the Pieridae, such as *Euchloe ausonia/crameri* and *E. (Elphinstonia) penia/charlonia*.

What are the valid names for the two genetically distinct taxa ?

1. HISTORY OF THE CASE

Whatever the rank accorded to the two taxa currently included within nominal *Pontia daplidice*, be it specific, semispecific or only subspecific, in all cases the same nomenclatural problems arise.



Figure 2. Distribution of *Pontia (daplidice) edusa* FABRICIUS in Germany. BRD : + = before 1960, * = after 1960 (SCHREIBER, 1976). DDR : circles = before 1950, spots after 1950 (REINHARDT & KAMES, 1982).

LINNAEUS (1758 : 468) gave the distribution of *daplidice* as "in Europa australi & Africa". Specimens preserved in the Linnean Collection (Linnean Society, London) lack locality data. Their exact origin cannot be determined. Southern Europe would include both taxa. VERITY (1913 : 176), after studying the Linnean Collection, wrote : "The specimen, which is obviously Linnean and bears his own label, is a female of the summer brood ; another female and a male are probably from Linnaeus' collection as well. They all three belong to the large European race, with the black markings widespread and their outlines diffused and with broad and vividly green markings on the underside". These Linnean specimens may or may not be types. They could have been added to the collection by LINNAEUS (or others) after the original description appeared in 1758. LINNAEUS (1758 : 468) also referred to works by PETIVER and by RAY. PETIVER's specimens were from Cambridge, England, and RAY's possibly from Portugal. The latter material is lost, probably destroyed, but (according to VANE-WRIGHT, pers. comm.) a single female exists in the Petiver Collection, now in the British Museum (Natural History) (BMNH) which could be one of the specimens indirectly referred to by LINNAEUS — but there is no conclusive proof of this.

FABRICIUS (1775 : 471) included males from Africa under *daplidice* LINNAEUS, 1758. Two years later (FABRICIUS, 1777 : 255) he described a female from the Kiel district under a new name, *Papilio edusa*. For reasons described above (2.8 ; see also Fig. 2), material from Schleswig-Holstein are regarded as belonging to the eastern form.

ESPER (1783 : 163, pl. 84, fig. 3) described and illustrated a male *Pontia* under the name *Papilio raphani*, which he considered to represent a species closely related to *daplidice* LINNAEUS. However, despite the fact that his specimen apparently came from Russia (ex BOEBER, from the Wolga region, between Sarepta and Saratov ; see ESPER, 1783 : 157-160), it is currently accepted that *raphani* is merely a synonym of the purely South- and East African species *Pontia helice* LINNAEUS, 1764 (see CHARPENTIER in ESPER, 1830 : 31-32 ; DUPONCHEL, 1835 : 383 ; OBERTHÜR, 1909 : 122-124 ; GRAVES, 1925 : 85, and TALBOT, 1932 : 285).

FABRICIUS (1787 : 23) associated the name *Papilio edusa* with the species now known as *Colias crocea* FOURCROY, 1785, from Spain. In so doing, FABRICIUS created a junior homonym of his own *Papilio edusa* FABRICIUS, 1777, and a junior subjective synonym of *Papilio croceus* FOURCROY.

OCHSENHEIMER (1808 : 159), referring back to the description of an unnamed species given by BRAHM (1791 : 362-363), described specimens of spring generation *daplidice* from Leipzig and Vienna, under the name *bellidice*. ACKERY & VANE-WRIGHT dissected males from Leipzig and Vienna, and

WAGENER a male from Bensheim a.d. Bergstr. All appear to represent the eastern form.

GEYER (1832 : pl. 189, figs. 931-934) figured *daplidice*-like specimens under the name *Papilio belemida*. HEMMING (1937) showed the type-locality to be Provence (France) (1937, HÜBNER, 1 : 219).

BIENERT (1869 : 26) described *persica* as a variety of "*Pieris daplidice* L." from north-eastern Iran.

KIRBY (1871 : 451) placed *Papilio edusa* FABRICIUS, 1777, as a junior synonym of *Papilio daplidice* LINNAEUS.

OBERTHÜR (1881 : 47) published the name *Pieris daplidice* var. *albidice* for material from Algeria. OBERTHÜR applied the name to specimens of the summer generation with strongly reduced markings on both surfaces of the hindwings.

2. DISCUSSION

2.1. With conventionally preserved type-material precluded from electrophoretic study, only examination of the male valves can give useful guidance as to which taxon a particular specimen belongs. This is not always very helpful, as already suggested. However, ACKERY dissected the male in the Linnean Collection (Fig. 3) ; apparently it most probably belongs to the eastern form. Thus it is probable that the male specimen in LINNAEUS'S collection originated from anywhere in central or south-eastern Europe, or even from England.

No reliable type-material is known for the nominal species-group taxa *edusa* FABRICIUS, 1777, *raphani* ESPER, 1783, *edusa* FABRICIUS, 1787 (nec 1777), *bellidice* OCHSENHEIMER, 1808, *belemida* GEYER, 1832, and *persica* BIENERT, 1869.



Figure 3. *Pontia (daplidice) edusa* FABRICIUS : Left valve of the male in Linnean Collection. Dissected by P. R. ACKERY, sketch by Mrs. R. ARORA.

The male specimen of *albidice* figured by OBERTHÜR (1888 : pl. 5, fig. 12) is preserved in the BMNH, and has been dissected by the author. The valves are of type 4, and thus suggestive of the western form.

Two years after his death, OCHSENHEIMER's collection passed to the Hungarian Natural History Museum, Budapest, but a large part of his material was destroyed in 1838 by a flood. In what remains there is only one female of *daplidice* (labelled "*Daplidice* L. Hungar"), which is of the summer generation and therefore cannot be part of the original series of *bellidice*. In the TREITSCHKE collection, also deposited (in 1843) in Budapest, there are two males (no. 571) and a pair (no. 572) of the first generation, as well as a male (no. 568) and a pair (no. 569) of the second generation of *daplidice*. The "Catalog der Sammlung europäischer Schmetterlinge des Friedrich Treitschke in Wien" lists two pairs and a variety of *daplidice*, and two pairs of "*daplidice*, var. *bellidice*". None of the TREITSCHKE specimens bears a locality label, and his *bellidice* specimens cannot be considered as original type-material of *bellidice* OCHSENHEIMER, 1808. ACKERY dissected three males (no. 571, 568 and 569) ; two had valves of the eastern form, and one of the western form.

Thus there remain just three potential types : the female in the LINNAEUS collection preserved by the Linnean Society London (*daplidice*), the female in the PETIVER collection preserved in the BMNH (*daplidice*), and the male of *albidice* OBERTHÜR in the BMNH. However, it is premature to fix types at this stage for either taxon. The development of new techniques (such as cuticular hydrocarbon analysis), or the refinement of existing methods, may make this appropriate in the future.

2.2. The two oldest available names are *Papilio daplidice* LINNAEUS, 1758, and *Papilio edusa* FABRICIUS, 1777. As LINNAEUS gave "Europa australis & Africa" as the distribution of *daplidice*, I apply this name to the western form (taxon 1 of GEIGER & SCHOLL 1982), and restrict the type-locality for *daplidice* to northwest Africa. The name for the eastern form (taxon 2 of GEIGER & SCHOLL, 1982) then becomes *edusa*, as specimens from Schleswig-Holstein (Kiel) belong to the eastern taxon. Despite the fact that use of the name *edusa* FABRICIUS, 1777 might conceivably create some confusion (because *Papilio edusa* FABRICIUS, 1787 (nec 1777) was frequently used for *Colias crocea* FOURCROY, 1785), I am convinced that this is the simplest and likely to be the most stable course of action. *Papilio edusa* FABRICIUS, 1777, is an available name, and any other action would complicate the nomenclatural situation still further, and require recourse to the International Commission on Zoological Nomenclature.

The next oldest name is *Papilio bellidice* OCHSENHEIMER, 1808 (type-localities : Leipzig and Wien). Dissection of males from Leipzig and Vienna

suggests the eastern form. I therefore place *bellidice* as a junior subjective synonym of *edusa* FABRICIUS, 1777, representing the generatio vernalis.

From the distribution of western and eastern forms as revealed by electrophoresis, the name *Papilio belemida* GEYER, 1832 (type-locality: Provence), should be regarded as a junior subjective synonym of *daplidice* LINNAEUS, 1758.

Specimens from north-eastern Iran cannot be assigned without electrophoretic analysis. Assuming, as seems likely, they belong to the eastern taxon, the name *persica* BIENERT, 1869, would become a junior subjective synonym of *edusa* FABRICIUS, 1777. If, on the other hand, the western form proves to occur in north-eastern Iran, the name *iranica* BIENERT, 1869, would become a junior subjective synonym of *daplidice* LINNAEUS, 1758. However, in either case the name *iranica* may eventually prove to have a valid use at subspecific rank. But if both eastern and western forms prove to occur in north-eastern Iran, a neotype designation for *iranica* would be required.

According to its valves, the male figured by OBERTHÜR (1888 : pl. 5, fig. 12) as *albidice* belongs to the western taxon, as do all specimens from North Africa examined by electrophoresis. The name *albidice* has been in general use, either as an aberration, form or subspecies of *Pontia daplidice*, but is regarded here as a junior subjective synonym of *P. daplidice daplidice* LINNAEUS, 1758.

Based on the preceding discussion, a detailed synonymy is presented below which should clarify the situation and promote a stable nomenclature for the Bath White butterflies.

Pontia (superspecies) daplidice

Pontia (daplidice) semispecies daplidice (LINNAEUS, 1758)

Papilio (Danai candidi) Daplidice LINNAEUS, C., 1758 (*Systema naturae* (ed. 10) 1 : 468, no. 62).

Locus typicus : North-west Africa (herewith restricted and designated).

Presumed distribution : Southern France, Spain, Portugal, Morocco, Algeria, Tunisia, Corsica, Sardinia, Israel, Jordan, Lebanon, southern Turkey, Iraq, southern Iran, Afghanistan, Kasachstan. As migrant perhaps within the area of *Pontia (daplidice) edusa* FABRICIUS, 1777.

SYNONYMS

Papilio Belemida GEYER, C., 1832 (Continuation of HÜBNER, J., *Sammlung europäischer Schmetterlinge*, Papiliones pl. 189, figs. 931-934). Locus

typicus : Provence, France (HEMMING 1937, HÜBNER, 1 : 219). Type-material not known. — Junior subjective synonym to *Papilio (daplidice) daplidice* LINNAEUS, 1758.

Pieris Daplidice, Linné, var. *Albidice* OBERTHÜR, C., 1881 (Lépidoptères d'Algérie — Études d'Entomologie, 6 (3) : 47). Locus typicus : Algeria (Constantine and Oran Provinces). Syntypes : British Museum (N.H.), London. — Junior subjective Synonym to *Pontia daplidice daplidice* LINNAEUS, 1758.

Leuc. dipl. laenas nov. subsp. FRUHSTORFER, H., 1908 (Neue palaearktische Pieriden — Ent. Z., 22 (12) : 51). Locus typicus : Palästina. Holotype : British Museum (N.H.). — Junior subjective synonym to *Pontia daplidice daplidice* LINNAEUS, 1758 (see LARSEN & NAKAMURA, 1983 : 160).

daplidice "race" *aethiops* JOANNIS & VERITY, 1913 (Boll. Soc. ent. It., 44 : 120, fig. 2). Locus typicus : Ethiopia. Type-material not known. — Junior subjective synonym to *Pontia daplidice daplidice* LINNAEUS, 1758 (see LARSEN, T.B., 1983 : 350).

daplidice subspec. *iberidice* BRYK, F., 1940 (Arch. Zool. 32 A (22) : 7 ; pl. 2, fig. 9). Locus typicus : Sierra Nevada. Type : (?) Naturhistoriska riksmuseet, Stockholm. — Junior subjective synonym to *Pontia daplidice daplidice* LINNAEUS, 1758.

INFRASUBSPECIFIC NAMES

daplidice var. *sulphurea* ♂ OBERTHÜR, C., 1884 (Bull. Soc. ent. Fr. : LXXXV). Locus typicus : Biskra, Algeria. Type-material : British Museum (N.H.).

daplidice ♀ *flavescens* OBERTHÜR, C., 1888 (Études d'Entomologie, 12 (3) : 22). Locus typicus : Biskra et Timgad, près Lambèse (Algeria). Type-material : British Museum (N.H.). As "*flava*" figured by OBERTHÜR 1896 (Études d'Entomologie, 20 : pl. I, fig. 8).

daplidice ab. ♀ *conjugata* MEZGER, 1930 (Lambillionea, 30 : 179). Locus typicus : Beauvallon (Var), France. Holotype : ♀ ; whereabouts not known.

daplidice hiberna n.f. (gen. autumn.) CHNEOUR, A., 1934 (Ent. Z. Frankf., 48 : 42). Locus typicus : Tunesia. Whereabouts of type-material not known.

daplidice chikita GOMEZ BUSTILLO, M. R., 1971 (Soc. Cienc. Nat. Aranzadi, Publ. 19 : 21-22. Locus typicus and type-material not known to me.

Pontia (daplidice) semispecies edusa (FABRICIUS, 1777)

Papilio D.C. Edusa FABRICIUS, J. C., 1777 (Genera insectorum. : 225). Locus typicus : "Chilonii" (Kiel). Type-material : "Dom. de Sehestedt" ;

whereabouts of the only female not known. Presumed distribution : Central Europe (eastwards of the Saône, Moselle, Rhine, Weser), Gotland, eastern Europe, Italy, south-eastern Europe, Turkey, Transcaucasia, north-eastern Iraq and north-western and northern Iran. As migrant perhaps within the area of *Pontia (daplidice) daplidice* LINNAEUS, 1758.

SYNONYMS

Papilio bellidice OCHSENHEIMER, F., 1808 (Die Schmetterlinge von Europa, I, 2 : 159). Locus typicus : Leipzig and Wien. Type-material destroyed by flood. — Junior subjective synonym to *Pontia (daplidice) edusa* FABRICIUS, 1777, generatio vernalis.

Pieris Daplidice L. var. *persica* BIENERT, Th., 1869 (Lepidopterologische Ergebnisse einer Reise in Persien : 26). Locus typicus : North-east Iran. Type-material not known. — Taxonomical status not yet clear ; here accepted as a junior subjective synonym to *Pontia edusa* FABRICIUS, 1777 at species level.

INFRASUBSPECIFIC NAMES

daplidice ab. *anthracina* SCHULTZ, O., 1904 (Ent. Z., 18 (22) : 85). Locus typicus : Heinrichau (Germany). Type-material not known.

daplidice L. var. *jachontovi* KRULIKOVSKY, L. K., 1908 (Soc. ent., 23 : 3 ; generatio tertia). Locus typicus : Russia orientalis et Asia centralis. Type-material not known.

Pieris daplidice forme *nitida* VERITY, R., 1908 (Rhopalocera Palaearctica : 132 ; pl. XXX, fig. 9). Locus typicus (partim) : “Phanaraki, Bosphore, Asie Mineure”. Syntypes : Museo Zoologico de “La Specola” Firenze.

daplidice ab. *rondoui* VERITY, R., 1908 (Rhopalocera Palaearctica : 132 ; pl. XXX, fig. 12, 13). Locus typicus : “Hongrie”. Type-material : (?) British Museum (N.H.).

daplidice ab. *flavopicta* VERITY, R., 1908 (Rhopalocera Palaearctica (no description) : pl. XXX, fig. 11). Locus typicus : “Forte dei Marmi, côte Toscane”. Nomen collectivum (VERITY, 1908, Rhop. Pal. : 166).

daplidice ab. *anastomosica* STRAND, E., 1909 (Int. ent. Z. Guben, 3 (14) : 78). Locus typicus : Ereğli, Konya, Turkey. Type-material not known.

daplidice ab. *minor* KSIENSZOPOLSKI, 1911 (Trav. Soc. Volhynie, 8 : 25). Locus typicus : Volhynia. Type-material not known.

daplidice zapellonii ROSTAGNO, F., 1911 (Boll. Soc. zool. It., 12 (Addenda). Locus typicus : Oricola, Formia, Italy. Type-material not known.

daplidice ♀ *eluta* VERITY, R., 1911 (Rhopalocera Palaeartica : 327 ; pl. L, fig. 29). Locus typicus : Elba. Holotype : Museo Zoologico de "La Specola" Firenze.

daplidice ab. *minuscula* VERITY, R., 1911 (Rhopalocera Palaeartica : 327 ; pl. LXVI, fig. 12). Locus typicus : Sarepta. Type-material : (?) British Museum (N.H.).

daplidice ♀ *ochrea* VERITY, R., 1911 (Rhopalocera Palaeartica : 327). Locus typicus : Sud de la Russie. No type-material known.

daplidice bimaculata ROCCHI, U., 1919 (Atti Soc. ligust. Sci. nat. geogr., 30 : 32). Locus typicus and type-material not known.

daplidice ampla VERITY, R., 1919 (Entomologist's Rec. J. Var., 31 : 87). The combination of the name *ampla* with *Pontia daplidice* is a "lapsus calami" and has been corrected by VERITY, 1919 (Entomologist's Rec. J. Var., 31 : 121) to the combination with *Colias crocea* FOURCROY, 1785.

daplidice expansa VERITY, R., 1919 (Entomologist's Rec. J. Var., 31 : 87 ; generatio secunda). Locus typicus : Toscana. Syntypes : Museo Zoologico de "La Specola" Firenze.

daplidice nana VERITY, R., 1922 (Entomologist's Rec. J. Var., 34 : 124). Nomen collectivum (VERITY, 1908, Rhopalocera Palaeartica : 166).

daplidice octobris VERITY, R., 1923 (Entomologist's Rec. J. Var., 35 (Suppl.) : (17) ; generatio quinta). Locus typicus : Colline di Firenze, Toscana, Italy. Syntypes : Museo Zoologico de "La Specola" Firenze.

daplidice subalbidice VERITY, R., 1923 (Entomologist's Rec. J. Var., 35 (Suppl.) : (17) ; generatio tertia). Locus typicus : Forte dei Marmi, Lucca, Italy. Syntypes : Museo Zoologico de "La Specola" Firenze.

daplidice zellerica VERITY, R., 1923 (Entomologist's Rec. J. Var., 35 (Suppl.) : (17) ; generatio prima). Nomen nudum.

daplidice gen. vern. *bellidice* O. ab. *alba* MÜLLER, E., 1930 (Intern. ent. Z. Guben, 24 : 154). Locus typicus : Zepernick/Mark, Germany. Type : 1 ♂ ; whereabouts unknown.

daplidice ab. ♂ *nitschei* GORNIK, F., 1932 (Z. österr. Ent. Ver., 17 : 81). Locus typicus : Niederösterreich, Ungarn, Dalmatien. Syntypes e coll. NITSCHKE in coll. WAGENER, Bocholt.

daplidice mediodilata VERITY, R., 1947 (Le farfalle diurne d'Italia, 3 : 180). Locus typicus : Elba, Italy. Holotype, ♀ : Museo Zoologico de "La Specola" Firenze.

daplidice nigrans VERITY, R., 1947 (Le farfalle diurne d'Italia, 3: 178). Locus typicus: Gran Sasso Abruzzi, Italy. Holotype, ♀: Museo Zoologico de "La Specola" Firenze.

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References

- BIENERT, Th., 1869. Lepidopterologische Ergebnisse einer Reise in Persien in den Jahren 1858 und 1859. 56 pp., Leipzig.
- BRAHM, Nikolaus Joseph, 1791. Handbuch der ökonomischen Insektengeschichte in Form eines Kalenders bearbeitet. Zweiten Teiles Erste Abteilung. Mainz.
- CHARPENTIER, Toussaint von, [1830] (1805-1830). Continuation of ESPER, Eugen Johann Christoph: Die Schmetterlinge in Abbildungen nach der Natur mit Beschreibungen, Supplement, Teil 2, 48 pp., pls. 117-126.
- DUPONCHEL, P. A. J., [1835]. Continuation of GODART, J. B., 1820-1844: Histoire naturelle des Lépidoptères ou Papillons de France. Diurnes. Supplément, Tome 1, Livr. 22 and 23.
- ESPER, Eugen Johann Christoph, [1783] (1780-1786). Die Schmetterlinge in Abbildungen nach der Natur mit Beschreibungen, Theil I, Fortsetzung der Tagschmetterlinge. 190 pp., pls. 51-93. Erlangen, W. Walthers.
- FABRICIUS, Johann Christian, 1775. Systema Entomologiae, sistens Insectorum classes, ordines, genera, species, adjectis synonymis, locis, descriptionibus, observationibus. 832 pp. Flensburgi et Lipsiae in Officina Libraria Kortii.
- FABRICIUS, Johann Christian, [1777]. Genera Insectorum eorumque characteres naturales secundum numerum, figuram, situm et proportionem omnium partium oris adiecta mantissa specierum nuper detectarum. 16 + 310 pp. Chilonii litteris Mich. Fried. Bartschii.
- FABRICIUS, Johann Christian, 1787. Mantissa Insectorum, sistens eorum species nuper detectas adjectis characteribus genericis, differentiis specificis, emendationibus, observationibus. Tomus II. 382 pp. Hafniae, Impensis Christ. Gottl. Proft.
- GEIGER, Hansjürg & SCHOLL, Adolf, 1982. *Pontia daplidice* (Lepidoptera, Pieridae) in Südeuropa — eine Gruppe von zwei Arten. *Mitt. schweiz. ent. Ges.*, **55**: 107-114.
- GEIGER, Hansjürg, DESCIMON, Henri & Adolf SCHOLL, 1988. Evidence for speciation within nominal *Pontia daplidice* (LINNAEUS, 1758) in southern Europe (Lepidoptera: Pieridae). *Nota lepid.*, **11** (1): 7-20.
- GEYER, Carl, [1832]. Continuation of HÜBNER, Jacob: Sammlung europäischer Schmetterlinge. Part I. 207 pls. Augsburg, 1796-1838.

- GRAVES, P. P., 1925. The Rhopalocera and Grypocera of Palestine and Transjordan. *Trans. ent. Soc. London*, 73 : 17-125.
- HEMMING, Francis, 1937. HÜBNER. A bibliographical and systematic account of the entomological works of Jacob HÜBNER and of the supplements thereto by Carl GEYER, Gottfried Franz von FRÖLICH und Gottlieb August Wilhelm HERICH-SCHÄFFER. Vol. 1 : XXXIV + 605 pp., vol. 2 : IX + 274 pp. Royal entomological Society, London.
- KIRBY, W. F., 1871. A Synonymic Catalogue of Diurnal Lepidoptera. 690 pp., London.
- KUDRNA, Otakar, 1983. An annotated Catalogue of the Butterflies (Lepidoptera : Papilionoidea) named by Roger VERITY. *J. Res. Lepid.*, 21 (1982) (1) : 1-106.
- LARSEN, Torben B., 1983. Insects of Saudi Arabia. Lepidoptera ; Rhopalocera (A Monograph of the Butterflies of the Arabian Peninsula). *Fauna of Saudi Arabia*, vol. 5 : 333-478, 2 col. pls.
- LARSEN, Torben B. & NAKAMURA, Ichiro, 1983. The Butterflies of East Jordan. *Entomologist's Gazette*, 34 (1983) : 135-208.
- LEMPKE, B.-J., 1934. *Pontia daplidice* L. et ses formes. *Lambillionea*, 34 (Oct. 1934) : 194-208.
- LINNAEUS, Carolus, 1758. *Systema Naturae... Tomus I. Editio Decima, Reformata*. 824 pp. Holmiae, Impensis Direct. Laurentii Salvii.
- OBERTHÜR, Charles, 1881. Lépidoptères d'Algérie. *Études d'Entomologie*, 6 (3) : pp. XLI-XLIV, 45-96, pls. I-XI. Rennes.
- OBERTHÜR, Charles, 1888. Lépidoptères d'Europe et d'Algérie. *Études d'Entomologie*, 12 (3) : 21-46, pls. V-VII. Rennes.
- OBERTHÜR, Charles, 1909. Notes pour servir à établir la Faune Française et Algérienne des Lépidoptères. Rhopalocera. *Études de Lépidoptérologie comparée*, 3 (6) : 101-404, pls. 11, 16-20, 23-26. Rennes.
- OCHSENHEIMER, Ferdinand, 1808. Die Schmetterlinge von Europa, vol. 2 : XXIV + 256 pp. Leipzig, bei Gerhard FLEISCHER dem Jüngern.
- REINHARDT, Rolf & KAMES, Peter, 1982. Beiträge zur Insektenfauna der DDR. Lepidoptera – Rhopalocera et HesperIIDae. I Allgemeiner Teil, Papilionidae – Pieridae – Satyridae. *Ent. Nachr. Ber.*, Beiheft 1 (1982), 72 pp., 43 maps.
- SCHREIBER, Harald, 1976. In MÜLLER, Paul (Editor) : Fundortkataster der Bundesrepublik Deutschland. Teil 2 : Lepidoptera. Familien Papilionidae, Pieridae und Nymphalidae. 75 pp. Schwerpunkt Biogeographie. Universität des Saarlandes. Saarbrücken.
- TALBOT, G., 1932-1935. Pieridae. In STRAND, Embrik : *Lepidopterorum Catalogus*, vol. 23, parts 53, 60, 66. 697 pp. W. Junk, Berlin, 's-Gravenhage.
- VERITY, Roger, 1913. Revision of the Linnean Types of Palaeartic Rhopalocera. *J. Linn. Soc. London, Zool.*, 32 (1911-1916), no. 215 : 163-194.
- WEIDEMANN, Hans-Josef, 1986. Tagfalter. Band 1. Entwicklung – Lebensweise. Neumann-Neudamm (JNN Naturführer), 288 pp., many pls. in colour.